UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

November 26, 1997

Baldwin Park Operable Unit Steering Committee
c/o Donald E. Vanderkar
Aerojet General Corporation
Box 13222
Sacramento, CA 95813

Subject: EPA Review of Technology Screening for the Treatability of Perchlorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin, September 29, 1997

Dear Mr. Vanderkar:

We have completed our review of the perchlorate technology screening report prepared by Harding Lawson Associates for the Baldwin Park Operable Unit Steering Committee. The full title of the report, dated September 29, 1997, is *"Technology Screening for the Treatability of Perchlorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin."*

We have been pleased with the Steering Committee's prompt response to the discovery of perchlorate at the Baldwin Park Operable Unit earlier this year. Installation of the new groundwater wells is proceeding, and pilot-scale testing of the biochemical reduction process appears to be on track.

Our main concern is the absence of any commitment by the Steering Committee to evaluate or develop technologies other than the biochemical reduction process. We are hopeful that the biochemical reduction process will prove effective and implementable, but the outcome of current evaluations is uncertain. In the next several weeks, we expect to have preliminary information about the technology's capability to reduce perchlorate concentrations to below the 18 microgram per liter interim action level, but even if this capability is demonstrated, considerable uncertainty is likely to remain about the implementability of the technology. Questions remain about cost, State regulatory agency approval, and the willingness of consumers and water agencies to accept the treated water.

Given that the uncertainty may persist well into 1998, we believe that it would be unwise to make continued progress at the Baldwin Park Operable Unit dependent on the uncertain success of the biochemical reduction process. We strongly believe that additional effort must be devoted concurrently to evaluating and developing other perchlorate-removal technologies. And as the Steering Committee has pointed out, the biochemical reduction process, while promising, is likely to be expensive to build and operate, perhaps exceeding the cost of VOC removal. Other perchlorate-removal technologies may be less expensive.

The screening report concludes that five technologies, in addition to biochemical reduction, have "strong potential" for effectively removing perchlorate from groundwater. We do not expect the Steering Committee to fund studies of all five technologies. **We request that the Steering Committee complete further testing of two of the top-ranked technologies over the next several months.**

We are open to Steering Committee recommendations on which two technologies should be tested. If ion exchange is selected, the first step would be to provide the results of previous testing. The next step, most likely, would be to conduct bench-scale flow-through studies of ion exchange resins in which candidate resins and regenerants are tested through multiple cycles of sorption and regeneration. We have been told that major ion exchange resin manufacturers will, at no charge, often provide resins for testing or complete initial testing themselves.

We are also open to cost-sharing or work-sharing arrangements between the Steering Committee and other qualified groups or institutions interested in conducting perchlorate-related treatment studies. A joint effort would reduce Steering Committee costs and reduce the risks of relying on third parties to complete needed studies. If properly structured, a joint effort should ensure that needed treatment studies are promptly initiated, that the studies meet EPA and Steering Committee information needs, and that EPA and the Steering Committee receive frequent progress reports and complete study results in a timely manner. The next several months are a critical period for perchlorate-related treatment studies. We are aware that the American Water Works Association Research Foundation (AWWARF) hopes to begin long-term perchlorate-related studies by the middle of next year, but it does not appear that the AWWARF-sponsored studies will provide results in time to support treatment decisions at the Baldwin Park Operable Unit.

We encourage you to carry out one related task. We recommend that you meet with representatives of Applied Process Technology to evaluate their efforts to remove perchlorate with a combined oxidation/ GAC treatment process. If Applied Process Technology's continuing evaluations are successful, additional investigations into oxidation processes may be warranted.

The remainder of our comments on the screening report are provided in an enclosure. **We would appreciate a response to this letter by December 12, 1997, including a clear statement of the Steering Committee's willingness to carry out additional studies of perchlorate-removal technologies.** If the Steering Committee intends to carry out additional testing, please include an anticipated date for submittal of a workplan for additional studies. If the Steering Committee prefers to focus its efforts solely on the biochemical reduction process, EPA and its contractors are prepared to carry out additional treatment studies.

Sincerely,

Wayne Praskins
EPA Project Manager

Enclosure

EPA Comments on "Technology Screening for the Treatability of Perchlorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin," dated September 29, 1997

Page/ Section	Comment
Page 1/ Section 1.1	The statement that "insufficient information is known about the long-term effects of low concentrations ...on human health" applies to most contaminants, not just perchlorate. All RfDs incorporate uncertainty or safety factors to account for limitations in the toxicological data; RfD uncertainty factors of 300 and higher are not unusual.
Page 3/ Section 1.2	There is a typographical or grammatical error in the last few sentences of Section 1.2
Page 3/ Section 1.3	The extracted groundwater will need to be replaced if the ultimate users of the water lack water rights in the San Gabriel Basin, not because the BPOUSC lacks water rights.
Page 5/ Section 1.5	The 3rd paragraph states the nitrate was reduced from 1.5 mg/l to *less than 0.5 mg/l.* Later, on Page 10 (2nd paragraph) the reports states that the nitrate was reduced from 1.5 mg/l to *less than 0.05 mg/l.* Which final concentration is correct? We understand that the full-scale biochemical reduction system being designed for Aerojet's Sacramento facility has a design capacity of 4,000 gpm, not 1,500 gpm.
Page 8/ Section 2.3	Were the words "oxyanion" or "oxyhalide" included in the key word search?
Page 9 / Section 3.1	The description of the chemical properties of perchlorate (e.g. its use as an oxidizer) applies to high concentrations of perchlorate in nonaqueous form. The text should also discuss perchlorate's properties (e.g., its stability) at low concentrations in water.
Page 10/ Section 3.3	Given the apparent effort to include all possible sources of nitrate, the list should include disposal of nitrate-containing wastes by industrial facilities in Azusa and surrounding areas.
Page 13 / Section 4.1.1	Would the presence of perchlorate limit the ability to regenerate the carbon? Would it remain in the carbon as ash? The text appears to use the word "regeneration" to refer to a high temperature carbon renewal process. Our understanding is that the term "regeneration" is typically used to refer to steam regeneration of carbon at temperatures less than 250 F. Higher temperature processes are more commonly referred to as reactivation.

Page 21/ Section 4.3.1	We encourage Steering Committee representatives to meet with representatives of Applied Process Technologies to evaluate their efforts to remove perchlorate with an advanced oxidation/ GAC treatment. If Applied Process Technologies' continuing evaluations are successful, additional investigations into oxidation processes may be warranted.
Page 22/ Section 4.3.3	The text states that sodium bisulfite, sodium sulfite, and sodium thiosulfate were tested for their ability to reduce perchlorate. "This method [chemical reduction] was demonstrated not to be effective at dosages of reducing agent as high as 1,000 mg/L..." Please specify the reducing agent and dosage, the initial and final perchlorate concentration, contact time, and other relevant data describing test methodologies and results. Were other reducing agents tested?
Page 23/ Section 4.3.5	We understand that Aerojet has completed tests with various metal catalysts. Please specify the catalysts, the initial and final perchlorate concentration, contact time, and other relevant data describing test methodology and results.
Page 26/ Section 5	We commend the attempt to rank the technologies, but do not agree with the selection or use of the ranking criteria. We would select different ranking criteria, weight them differently, and in many cases assign significantly different scores (e.g., How does a short carbon life make GAC less "reliable" or reduce its "acceptance"? Why is ion exchange penalized in "effectiveness" for generating a concentrated wastewater stream? Why does biochemical reduction receive a higher score for its "small" space requirement than ion exchange for its "modest space requirement?). In many cases, only general statements are provided to support assumptions that a given technology will require "large amounts of space" or have "high" costs, making it difficult to evaluate the assigned scores. In particular, we believe that Alternative A-1 (Biochemical Reduction) is scored too high: the technology is given the highest scores possible for "implementability" and "cost" despite the unproven nature of the technology at any scale, the need to add microbes, nutrients, and large quantities of alcohol or other electron donors to the water supply, the potential for unwanted reaction byproducts, the absence of State regulatory approval or consumer acceptance, and potential cost savings of other technologies. Biochemical Reduction is also given the highest score assigned to any technology for effectiveness despite the absence of evidence that it can reduce perchlorate to below the 18 ppb action level. We are not requesting that the technologies be rescored or reranked. Despite our disagreement with the methodology, we are in general agreement with the final ranking of technologies.

Page 28/ Section 5.3.2	*[Activated Carbon]:* Please provide a breakdown and explanation of the cost estimate, particularly the $16 million operation and maintenance estimate. Please discuss whether modest improvements in carbon life (or other less "worst case" estimates) could decrease costs to become competitive with biochemical reduction. We also believe that the LGAC process should be "credited" with savings on VOC treatment. If the carbon is changed as frequently as assumed (every 7 days), the carbon will remove perchlorate and most or all of the VOCs. In the Baldwin Park OU Feasibility Study, VOC treatment costs are estimated as $19 million capital and $2 million O&M.
Page 29/ Section 5.3.3	*[Ion Exchange]*: The text refers to "extensive bench-scale testing" of ion exchange by Aerojet. Please specify the ion exchange resins tested, the initial and final perchlorate concentrations, the performance curves mentioned in the second paragraph, empty bed contact time, the number of cycles tested, the type and concentration of regenerant, and other relevant data.
Page 37/ Section 5.3.12	We have spoken with researchers who have identified vanadium, titanium, ruthenium, and molybdenum catalysts as candidates for further study. One of the researchers has successfully reduced perchlorate in an aqueous solution at room temperature using a rhenium catalyst.
Page 40/ Section 5.4	The text carries forward six technologies for further evaluation: biochemical reduction, ion exchange, reverse osmosis, electrodialysis, activated carbon adsorption, and capacitive deionization. We believe that Catalyzed Chemical Reduction (Alternative A-12) and Chemical Oxidation (Alternative A-8) should also be retained as candidates. See cover letter.
Page 41/ Section 6.0	Our confidence in the cost estimates is low due to the absence of back-up documentation.
Page 43/ Section 6.1	*[Biochemical Reduction Using GAC/FB]* Biological sludge production may be significantly higher than estimated, increasing costs. Assuming a methanol feed of 2,500 gal/day, a sludge yield of 0.6 mg VSS/mg BOD, an alum dosage of 20% of the biological solids production, and a sludge moisture of 80%, we estimate the biological sludge production as 54 tons per day versus the stated 10 tons per day. If our sludge estimate is correct, a centrifuge or filter belt press is likely to be more economical than the plate and frame filter press suggested in the report for sludge dewatering. We note that the cost estimate assumes high-rate multimedia filters rather than slow sand filters, and does not include post-filtration treatment.

Page 44/ Section 6.2	*[Liquid Phase GAC]* LGAC costs may be significantly less than estimated if the LGAC removes a significant portion of the VOCs.
Page 47/ Section 6.4	*[Capacitive Deionization]* The assumed recovery of 95% seems extremely optimistic, exceeding typical RO system recovery by 10%. If a CDI system achieved 95% recovery, the brine would be three times stronger than in an RO system, risking scale buildup on the aerogel surface. Please specify the manufacturer and "reports by independent researchers" cited in the text.
Page 48/ Section 6.5	*[Reverse Osmosis]* What type unit is assumed? (e.g., plate and frame, spiral wound, hollow fine fiber, tubular membrane)
Page 49/ Section 6.6	*[Electrodialysis]* We believe that the assumption that the ED membranes will be replaced every 10 years is overly optimistic.
Page 50/ Section 6.7	*[Brine Treatment]* We note that if an ion exchange brine is added back into the treated water after perchlorate removal, the TDS in the treated water will increase significantly. Typical ion exchange regenerant solutions require a 250 percent stoichiometric excess of regenerant. Assuming significant portions of the sulfate are removed, the regenerant solution could increase TDS in the treated water by over 100 mg/l. We cannot tell whether a hook-up fee for the brine line was assumed in the cost estimate. In a recent CH2M HILL project, brine line hook-up cost the user $125,000 for 0.1 cfs (45 gpm) capacity. If the use of RO resulted in a discharge of 3,000 gpm, connection fees may be many millions of dollars. What is the rationale for the statement that "It is unlikely that untreated discharge to the ocean will be acceptable."
Page 51/ Section 6.7	In some conditions (e.g, high BOD), could activated sludge be more economical than GAC/FB? As described in an earlier comment, we believe that sludge production may be more than an order of magnitude higher than one to two tons per day, increasing brine handling costs for ion exchange, reverse osmosis, and electrodialysis.

Page 53, Section 7.0	We agree with the introduction to Section 7, which states that additional studies are necessary to "raise the level of knowledge of each [of the six potentially effective technologies] to a point where it can be compared with the other viable technologies, or to identify a factor or factors that make the technology unattractive for further consideration." To our disappointment, the technology-specific recommendations do not provide any commitment to carry out the studies needed to meet this goal. See cover letter for more detailed EPA response.
Page 54, Section 7.3	*[Ion Exchange]*: We believe that additional studies of ion exchange or other highly ranked technologies need to be carried out now. See cover letter for more detailed EPA response.
Page 55, section 7.5	*[Reverse Osmosis]* The report places the burden of evaluating this technology on vendors. See cover letter for EPA's position that the Steering Committee needs to commit to additional studies.
Table 3-1	Isn't specific gravity unitless? If the values are meant to be density, shouldn't the units be g/mL?